

Remarks

Receipt is acknowledged of the Office Action mailed December 18, 2003. Claims 1-4 were pending in the application. Claim 1 has been amended. No new matter has been introduced. Thus, claims 1-4 are submitted for reconsideration at this time.

Rejections Under 35 U.S.C. §112, ¶2

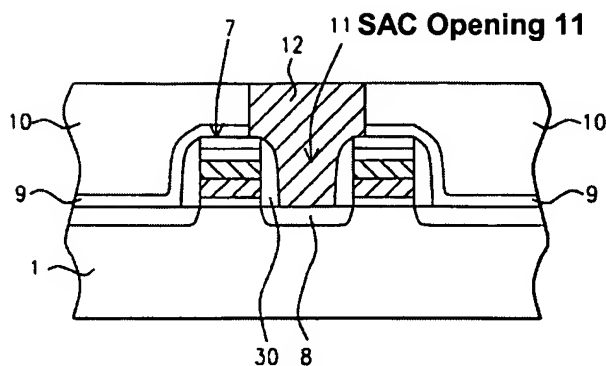
Claims 1-4 stand rejected under 35 U.S.C. §112, ¶2 as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Specifically, independent claim 1 originally recited "predetermined" which the Office Action asserts is indefinite. Applicants have amended claim 1 to remove the allegedly indefinite language. Withdrawal of the rejection under 35 U.S.C. §112, ¶2 is solicited.

Rejections Under 35 U.S.C §102(b)

Claim 1 stands rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 6,239,014 ("Liaw" hereafter). Applicants respectfully traverse this rejection for at least the following reasons.

Liaw fails to disclose or suggest subjecting the structure resulting from steps (a)-(c) to a plasma treatment using a mixture gas containing oxygen *to convert the polymer residual into a silicon oxide film* and performing a cleaning process *to remove the silicon oxide film* as presently recited in amended claim 1. Support for this amendment can be found, for example, on page 8, lines 6 to 10; and on page 8, line 19 to page 9, line 1, of the as-filed specification.

Specifically, Liaw discloses plasma oxygen ashing and wet cleaning *to remove a photoresist film for definition of self aligned contact (SAC) opening 11* ('014 spec. 3:59-61). See Figure 3 of Liaw, reproduced below for the Examiner's convenience.



Unlike Liaw, however, the plasma treatment and cleaning steps in the presently claimed invention are *not* used for removing the *photoresist film 112* shown in Fig. 2a of the as-filed specification. Rather, these steps are used, respectively, to convert the *polymer residual 116* from the plasma etching process into a silicon oxide film and to remove this silicon oxide film from the contact hole.

As Liaw fails to disclose or suggest such a process, Liaw also fails to anticipate the presently claimed invention. Withdrawal of the rejection under 35 U.S.C. §102(b) is solicited.

Rejections Under 35 U.S.C. §103(a)

Claims 1-4 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Liaw, in view of an article entitled "Characterization of the post dry-etch treatment for the cleanness of submicron contact hole buttons" ("Lee" hereafter). Claims 1-4 also stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,562,416 ("Ngo" hereafter) in view of U.S. Published Application No. 2002/0009893 ("Chung" hereafter) and further in view of Lee. Applicants respectfully traverse these rejections for at least the following reasons.

Liaw in view of Lee

The Office Action correctly acknowledges that Liaw fails to disclose:

1) the plasma treatment is performed using a plasma of NF₃/O₂/He mixture gas, plasma of ar/O₂ mixture gas, plasma of CF₄/O₂ mixture gas or plasma of CF₄/O₂/Ar mixture gas (claim 2); 2) the step (b), (c), and (d) are performed in a same chamber without intermittence (claim 3); and 3) the step (d) is performed in an ex-situ process in a separate plasma chamber (claim 4).

The Office Action fails to appreciate, however, that Liaw also fails to disclose or suggest subjecting the structure resulting from steps (a)-(c) to a plasma treatment using a mixture gas containing oxygen *to convert the polymer residual into a silicon oxide film* and performing a cleaning process *to remove the silicon oxide film* as previously discussed. Lee fails to rectify this deficiency in Liaw. As such, withdrawal of the rejection under 35 U.S.C. §103(a) over Liaw in view of Lee is solicited.

Ngo in view of Chung and Lee

The Office Action correctly acknowledges that Ngo fails to disclose "the oxygen plasma clean. Instead, Ngo teaches a nitrogen plasma clean." The Office Action asserts, however, that Chung teaches an oxygen plasma cleaning step for the case of having the low k dielectric layer made of FSG, and Lee teaches an ex-situ cleaning process for contact holes between wordlines in DRAM structures using NF₃/O₂/He plasma to clean the contact bottoms. The Office Action further asserts that it would have been obvious to have used the cleaning plasma treatment taught in Chung to clean the contact holes in Ngo, with the motivation that if the low k layer in Ngo were FSG specifically, then Chung's cleaning process would further improve on the contact reliability.

The Office Action fails to appreciate, however, that Ngo, Chung, and Lee all fail to disclose or suggest subjecting the structure resulting from steps (a)-(c) to a plasma treatment using a mixture gas containing oxygen *to convert the polymer residual into a silicon oxide film* and performing a cleaning process *to remove the silicon oxide film*. As none of the references disclose or suggest such a feature, this rejection is traversed. See MPEP §2143.03 (All Claim Limitations Must Be Taught or Suggested). Withdrawal of the rejection under 35 U.S.C. §103(a) over Ngo in view of Chung and Lee is solicited.

CONCLUSION

In view of the above amendment and remarks, Applicants respectfully request that all objections and rejections be withdrawn and that a notice of allowance be forthcoming. The Examiner is invited to contact the undersigned for any reason related to the advancement of this case.

Respectfully submitted,

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Heller Ehrman White & McAuliffe LLP
1666 K Street, N.W., Suite 300
Washington, D.C. 20006-4004
Telephone: (202) 912-2510
Facsimile: (202) 912-2020

A handwritten signature in black ink, appearing to read "D. L. Girdwood", written over a horizontal line.

Daniel L. Girdwood
Agent for Applicant
Reg. No.: 52,947

Customer No. 26633